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A NEW GENUS AND A NEW SPECIES OF BOREIDAE FROM OREGON (MECOPTERA)

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Abstract.—**Caurinus dectes,** a new species and a new genus, is described from the Coast Range of Oregon, USA. *Caurinus* possesses some diagnostic boreid characters (clasper-like forewings of male, fusion of basal sclerites of maxillae and labium into zygostipes) but also characters unusual or otherwise unknown for the Mecoptera, including: Armored body, anterior abdominal segments synscleritous; minute size (1.4–1.8 mm); genitalia concealed in both sexes; non-rostrate head; and short mandibles with a strongly developed molar blade. The female possesses unfused cerci and lacks the elongate ovipositor typical of other boreids.

Because of the divergence of *Caurinus* from other Boreidae, 2 subfamilies are recognized here: **CAURININAE** (new subfamily), including only *C. dectes,* and BOREINAE, including the genera *Boreus* and *Hesperoboreus.*

The Boreidae comprise 23 described species in two genera (*Boreus* and *Hesperoboreus*) (Svensson, 1972; Penny, 1977). These are insects of uniform, rather bizarre habitus, with an aggregate distribution limited to the Holarctic Zone. The insect described here, although related to the other boreids, is so distinctive that it was not at first recognized as a mecopteran on the basis of the external structure of the female alone. The considerable morphological-taxonomic distance from other living Mecoptera and the presence of some probably plesiomorphic characters not found in *Boreus,* justify its recognition as a new subfamily of the Boreidae.

Caurinus Russell, NEW GENUS

Diagnosis.—*Adult*: Strongly sclerotized, compact boreid. Head with short broad rostrum. Mandibles short, with large molar blade. First abdominal tergum fused to pterothorax, without free median sclerite; forewings short, slender, forceps-like in male; oval and pad-like in female; hind wings absent. Abdominal segments 2–6 synscleritous; segments 7 and 8 divided normally, sternum 9 forming hypandrium in male. Terminal segments, including gonopods of male, retracted. Aedeagus with complex sclerotized structures. Cerci 1-segmented in female, absent in male. Female with sclerotization of ovipositor limited to short median lobe of eighth sternum.

Larva: Curculionoid, similar to *Boreus* in structure but orthosomatic; head with 7 ocelli on each side, vertex angulate medially; thoracic legs reduced to short 1-segmented papillae.

Type Species.—*Caurinus dectes*, new species.

Description of Male (Figs. 1–3).—*Color*: Head and thorax reddish brown, abdomen chestnut brown, lateral and dorsal portions of abdominal segments 2–6 and hypandrium infuscated with black; eyes dark purplish brown; legs and forewings testaceous.

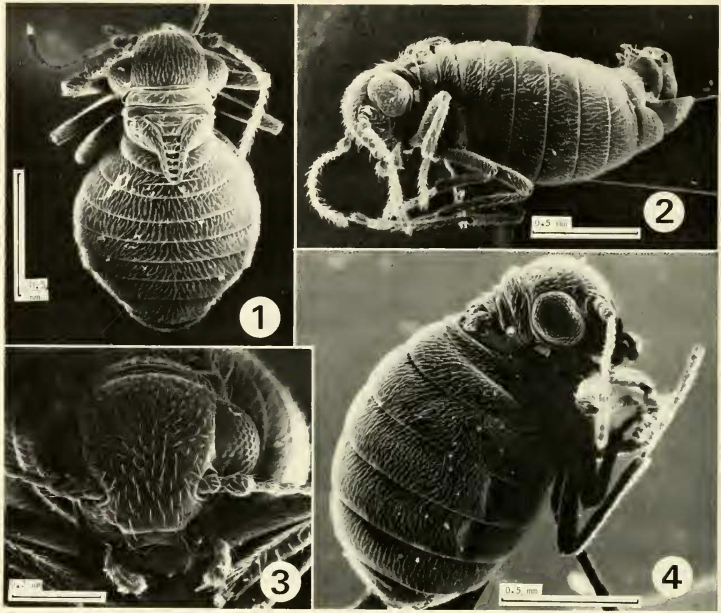
Vestiture and sculpture: Body and appendages clothed with moderately long pale pubescence, semierect on frons and vertex, decumbent elsewhere. Pterothoracic pleura and 2nd abdominal venter with shorter, much denser pubescence. Clypeus with pair of long lateral setae near base; pronotum with variable number of long, erect setae on inflexed lateral portion. Body surface between punctures obscurely microreticulate, shining.

Head: As broad as long (vertex to apex of labrum); frons and vertex convex. Eyes large, oval, convex, coarsely facetted, emarginate opposite antennal bases. Ocelli absent. Antennae approximately ½ body length, 16-segmented, inserted laterally on frons, slightly thickened near apex. Scape stout, cylindrical; pedicel large, pyriform; 3rd segment cylindrical; segments 4–15 elongate-ovoid. Last antennomere small, about ½ length and width of penultimate. Membrane of antennal socket recessed, much reduced in area.

Epistomal suture angulate medially, deeply impressed. Clypeolabral suture parallel to epistomal suture; clypeus transverse, chevron-shaped. Labrum broadly arcuately emarginate, not strongly sclerotized. Clypeogenal and subgenal sutures short; subgena confined to lateral surface of head. The occiput produced caudad as median, broadly triangular lobe. Postorbital ridge strongly developed as laterally prominent thin ridge adapting to anterior margin of prothorax. Hypostomal bridge long (.64 vertical diameter of eye); occipital foramen divided by corporatentorium.

Mandibles short, falcate, with 3 large acute teeth and hatchet-blade shaped mola (Fig. 8). Maxillae: Zygostipes transverse, crescentic, without median suture; palps 5-segmented; 4th segment inflated, with membranous concave medial surface; apical segment acicular, as long as 4th (Fig. 3). Prementum rhomboidal with narrow basal stalk; labial palps 2-segmented.

Thorax: Cervical membrane concealed. Lateral cervical sclerite slender, almost horizontal. Pronotum transverse, expanded forward over the occiput, partly covering propleura ventrally, with deep transverse furrow at posterior ⅓. Mesothoracic spiracle large, at caudal margin of pronotum 5× its diameter above ventral pronotal border. Propleuron subequally divided by propleural suture which is obsolete ventrally; proepisternum deeply incised at middle of anterior margin to receive cervical sclerite. Prosternum nearly as in *Boreus*, with paired short precoxal lobes, and slender furcal arms dorsally reaching strong pleural apodemes; procoxae contiguous at midline.



Figs. 1–4. Scanning electron photomicrographs of *Caurinus dectes*. 1, Dorsal view of male, genitalia retracted. 2, Lateral view of male, genitalia extruded. 3, Frontal view of male. 4, Lateral view of female. Numbers beside scale bars give scale in mm.

Pterothoracic segments fused with 1st abdominal tergum. Mesonotum large, alate; scutum transverse; scutellum quadrate, convex; area behind wing bases extensively membranous. Metascutellum large, rhomboidal, with strong posterior median keel; metanotum otherwise membranous. Mesopleuron excavated below wing bases; mesopleural suture vertical, extending only short distance from coxa; suture between mesepimeron and metepisternum indicated only by the small metathoracic spiracle. Metapleural suture only partially evident externally, directed obliquely anteriad for ½ metacoxal diameter. Metepimeron limited posteriorly by weak phragma; a short internal longitudinal plica present at posterior margin of pterothorax at level of metathoracic spiracle; rudimentary 1st abdominal spiracle above the anterior end of this plica.

Mesosternum broadly exposed between coxae, these separated by ⅓ coxal diameter at midline; metasternum exposed anterior and posterior to contiguous metacoxae. Meso- and metafurcae poorly developed, mesopleural

apophysis developed only ventrally near coxae; metapleural apophysis absent.

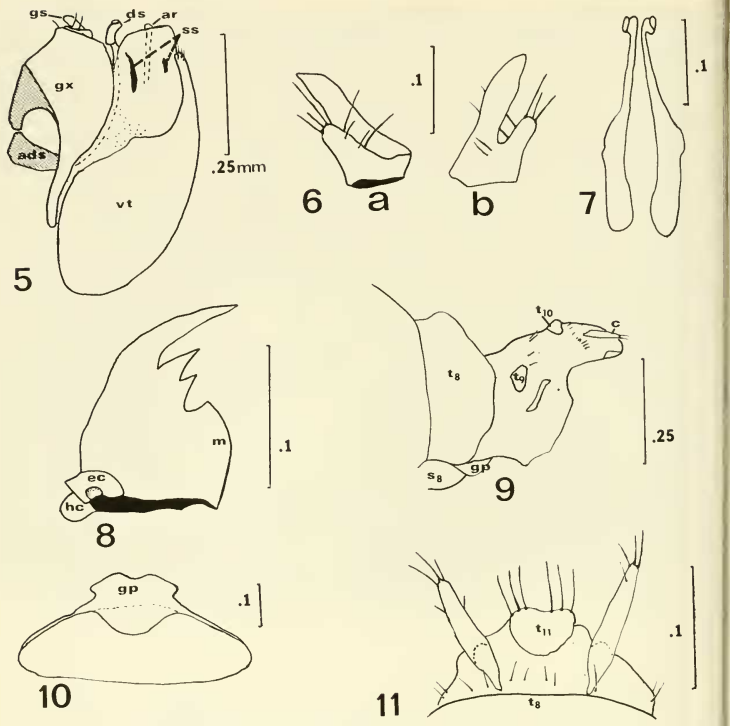
Mesothoracic wings modified as clasping organs as in male *Boreus*, but relatively much shorter, only reaching anterior margin of 2nd abdominal tergum; apical ⅔ bearing 6 evenly spaced stout spines, proximal spine shorter than other 4, terminal one much longer; with wings in repose, each spine crossing contralateral spine at midline. Metathoracic wings absent.

Legs short, increasing in length from pro- to metathorax; coxae moderate in length, oriented vertically; procoxae slender, base above level of ventral margin of eye; pterothoracic coxae stouter, metacoxae much the larger. Meron not recognizable in any coxa. Trochanters, femora, and tarsi unmodified, apical ½ of tibia and ventral surface of 1st tarsomere each bearing several spines. Tarsi 5-segmented, tarsomeres 1–4 of decreasing length. Pro- and mesotarsi shorter than corresponding tibiae; metatarsi longer than tibiae, basitarsus elongate, pretarsal claws small, simple.

Abdomen: Large, dorsal surface flattened; widest at segments 4 and 5; narrowed to broadly rounded hypandrium. Tergum 1 entire, fused with pterothorax, with strong median keel. Sternum 1 not sclerotized. Segments 2–6 annular, synscleritous, subequal in length, capable of slight telescoping. Segments 7 and 8 discleritous, pleural membranes concealed when genital capsule is retracted; terga 7 and 8 meet sterna in line ascending caudad when hypandrium is closed against tergum 8. Tergum 9 unsclerotized, membrane incorporated in genital capsule. Abdominal spiracles 2–6 small, set in segmental rings above middle of sides. Spiracles 7 and 8 at midlength of terga, distant from pleural membrane. Segments 10 and 11 (proctiger) slender; membranous, except for small transverse sclerite (possibly tergite 10). Cerci absent.

Genital capsule (Fig. 5) comprising 2-segmented gonopods, aedeagus with ventral sclerotized trough and strong arcuate dorsal sclerite; and proctiger. Gonocoxites not fused, robust, tapering basally to elongate lateral process; articulating by medial basal apodeme with basal apodeme of dorsal sclerite. Gonostyles (Fig. 6) flattened, deeply incised; basal tooth with 2 long setae on ectal surface and several smaller setae apically and on mesal surface; surface without coarse granules. Dorsal sclerite apically free from aedeagal membrane in spoon-shaped process; basally forming stout, laterally expanded apodeme. Lateral membranes of aedeagus bearing 2 pairs of spinose sclerites (Fig. 5). Distal portion of gonoduct with paired linear sclerites (aedeagal rods, Fig. 7).

Description of Female (Fig. 4).—Similar to male; more robust, abdomen stout, ovoid. Mesothoracic wings reduced to oval pads, shorter than mesonotum, sparsely pubescent; mesonotal sclerites less differentiated than in male, mesopleuron less excavated; metascutellum and abdominal tergum 1 medially convex, but not keeled. Abdomen subglobose, more evenly convex



Figs. 5–11. *Caurinus dectes*. 5, Genital capsule of male, left lateral view (shaded areas are apodemal). 6, Left gonostyle; a, anterior view and b, medial view. 7, Aedeagal rods, dorsal view. 8, Left mandible, anterior view. 9, Female terminal segments of abdomen, segments 9–11 extruded, in dorsolateral view. 10, Eighth sternum of female, internal view. 11, Dorsal view of female abdomen, segment 11 only extruded. Abbreviations: *ads*, basal apodeme of dorsal sclerite; *ar*, aedeagal rods; *c*, cercus; *ds*, dorsal sclerite of aedeagus; *ec*, epicondyle; *gp*, gonapophyses; *gs*, gonostyle; *gx*, gonocoxite; *hc*, hypocondyle; *m*, molar process; *s*, sternum; *ss*, spinose sclerites; *t*, tergum; *vt*, ventral trough of aedeagus. Numbers beside scale bars give scale in mm.

dorsally than that of male. Segments 2–6 annular as in male; segment 7 strongly tapered posteriorly, sternum and tergum equal. Segment 8 small; tergum inflexed, enclosing sides of sternum. Sternum 8 narrow, with apical process (gonopophyses) emarginate medially (Fig. 10). Segments 9–11 slender, normally retracted (shown extended in Fig. 9), largely membranous,

with weakly sclerotized tergite and linear laterotergites on segment 9, small median tergite 10, and tergum and sternum 11. Segments 9 and 10 bear subapical transverse series of setae. Tergum 9 may be entire, but is usually sclerotized only laterally. Cerci (Fig. 11) short, 1-segmented, articulated at base, separated by tergum 11.

Holotype.—♂, 1.58 mm long, collected II-22-76; 35 ♂ and 32 ♀ paratypes, collected I-22-76 to IV-4-76, VI-16-76, X-11-76, to IV-3-77, all from Marys Peak, Benton County, Oregon, USA, on the northeast ridge at 600 m elevation, collected by L. K. Russell, P. J. Johnson, G. L. Peters, and R. L. Westcott. Also designated as paratypes are specimens from OREGON: *Tillamook County*: Cascade Head, summit, 490 m elevation, XI-25-76, Johnson, collector (1 ♂); XII-19-76, Russell (1 ♀); Little Nestucca County Park, III-6-77, Russell (1 ♂); *Yamhill County*: Hanchet Creek, 12 km W Grand Ronde Agency, 185 m, XII-19-76, Russell (1 ♂); *Lincoln County*: Depot Creek, 8 km N Toledo, near sea level, III-6-77, Russell (1 ♀); *Lane County*: Klickitat Mountain, 520 m, I-23-77, Johnson (1 ♂); Cape Ridge, 7 km E Cape Perpetua, 430 m, I-9-77, Russell (1 ♀). The range of length is 1.4 to 1.75 mm (males) and 1.5 to 1.9 mm (females).

The holotype and a female paratype are deposited in the California Academy of Sciences, San Francisco. Paratopotypes are deposited in the British Museum of Natural History, Canada Department of Agriculture collection, Ottawa; Museum of Comparative Zoology, Harvard University; Oregon Department of Agriculture, Salem; Oregon State University, Entomology Museum; Snow Entomological Museum, University of Kansas; and United States National Museum. Other specimens and dissections are in my private collection, and in those of P. J. Johnson and G. L. Peters, Corvallis, Oregon, and K. W. Cooper, Riverside, California.

Habitat.—All *Caurinus* habitats are moist forested sites, with abundant epiphytic and terrestrial bryophytes, in the central Coast Range of western Oregon. The initial Marys Peak collections, and all from other sites, were obtained by Berlese funnel extraction from moss samples. Most Marys Peak specimens were collected by beating mossy stems of vine maple (*Acer circinatum* Pursh), or were washed from moss samples and recovered on #25 soil screens which retained particles larger than 0.7 mm diameter. *Rhytidiadelphus loreus* (Hedw.) Warnst. (Rhytidiaceae), *Metaneckera menziesii* (Hook.) Steere and *Neckera douglasii* Hook. (Neckeraceae) are the most abundant epiphytic mosses on stems with *Caurinus*, but many other bryophytes occur in this community. An abundant epiphytic liverwort, *Porella navicularis* (L. & L.) Lindb. (Porellaceae) is a favored food of adults and an oviposition site for *Caurinus*. *Hesperoboreus brevicaudus* (Byers) is also abundant at the Marys Peak site; both boreids appear to breed in epiphytic, rather than terrestrial, bryophytes at this locality.

At Cascade Head, *Caurinus* was found in terrestrial mosses (mostly *Rhy-*

tidiadelphus loreus) at the edge of a dense stand of young Sitka spruce (*Picea sitchensis* (Bong.) Carr.) within 2 km of the Pacific Ocean. Other localities are generally comparable to the Marys Peak site.

Etymology.—The generic name is derived from the Latin *caurinus*, "northwestern," referring to the northwest wind Caurus, and is analogous to *Boreus*, named for the Greek and Roman god of the north wind. *Dectes*, Greek, "a biter," refers to the strongly developed mandibles.

Discussion.—*Caurinus* differs from previously known boreids in many important characters. Of these the mouthparts, the abdominal structure and genitalia, and the virtually legless larvae are especially significant. The head of *Caurinus* is of normal proportions for a generalized mandibulate insect, and can hardly be termed "rostrate," while the rostrum of *Boreus* is unusually long for a plant-feeding mecopteran (Byers, 1968). *Brachypanorpa* (Panorpodidae) and the Nannochoristidae are the only other Mecoptera with a short rostrum, but in these groups the rostrum is markedly narrowed apically. The clypeolabral suture is present in *Caurinus*, but absent from all other adult Mecoptera (Hepburn, 1969). The short, strongly toothed mandibles contrast with those of all other Mecoptera. Byers (1968) characterized the Boreidae as having "short, thick mandibles," but the width/length ratio of the *Caurinus* mandible is about .58 while that of a robust *Boreus* mandible (e. g., *B. nivoriundus* Fitch) is near .30. The strong, arcuate molar blade of *Caurinus* is unlike any mandibular structure in other Mecoptera. Most Mecoptera, including *Boreus* and *Hesperoboreus*, lack cutting teeth or blades on the proximal half or more of the mandible; a cutting structure is best developed in *Brachypanorpa*, which has a thin, straight serrulate molar blade (Otanes, 1922).

A number of characters related to the extensive sclerotization and compactness of *Caurinus* contribute in large part to the peculiar habitus of this genus. These include the proportionately very small thorax and short appendages, particularly the extreme reduction of the notal and pleural structures of the metathorax. The abdominal structure of *Caurinus* is unique in the synscleritous anterior segments and discleritous posterior segments (7–11 in both sexes). The opposite pattern of abdominal fusions is common in other Mecoptera: Segments 2–5 are always discleritous; the synscleritous state may occur in any of segments 6–10 in males, and in segment 10 only of females. In *Boreus* and *Hesperoboreus*, all the pregenital segments are discleritous; in males, fusions occur only in segments 8 or 9 (Cooper, 1973), and in females only segment 10 can be considered synscleritous (Mickoleit, 1975). The retraction of the terminalia in both sexes of *Caurinus* is apparently related to the protective armor. Judging from the unfused and relatively unmodified cerci of female *Caurinus*, however, the lack in this genus of an exserted ovipositor formed from structures of segments 9–11 may be primary rather than a reduction. The terminal segments are partly retracted

in females of other mecopteran families, with each segment partly telescoping into the next anterior one (Mickoleit, 1975), rather than being withdrawn as a unit as in *Caurinus*.

In a review of the phylogeny of extant mecopteran families, Penny (1975) cited four characters in which boreids differ by reduction from the condition in supposed panorpid-like ancestors: in body size, wing development, number of antennal segments, and in size of male tergum 9. Each of these characters in *Caurinus* appears in a more specialized (reduced) state than any other known boreid. The legless larva and general extension of sclerotization in the adult also suggest that *Caurinus* has evolved through further specialization from a *Boreus*-like ancestor.

Caurinus is more similar to *Boreus* and *Hesperoboreus* in ecological and behavioral characteristics than in morphology. *Caurinus dectes,* like other boreids, has a winter adult emergence; and it feeds on bryophytes. When disturbed, *Caurinus* adults may hop several centimeters, usually landing with appendages drawn in, in the death-feigning posture typical for Boreidae. This avoidance hop is less constant than in most species of *Boreus* and *Hesperoboreus*; individuals of *Caurinus* may simply grip the substrate and remain immobile, or fall vertically, when they are touched.

Caurinus appears more generalized than other boreids in such characters as the free cerci of the female, the sutures of the head, sclerotization of the aedeagus, and the more complex larval eye. These, together with the numerous divergent characters listed above, make a paraphyletic origin of *Caurinus* within the *Boreus-Hesperoboreus* lineage unlikely. The many differences between *Caurinus* and other boreids appear to justify a separation at higher than generic level. To accommodate this morphological gap, I propose the recognition of 2 subfamilies of Boreidae: CAURININAE (NEW SUBFAMILY), presently including only *C. dectes,* and BOREINAE, which includes all other known boreids. The subfamilies and genera of the Boreidae may be separated by the following key:

Key to the Subfamilies and Genera of the Boreidae

1. Head not rostrate; male gonopods and female segments 9–11 enclosed in abdomen (1 species, Oregon, USA) (CAURININAE) .... *Caurinus*, new genus
– Head strongly rostrate; male gonopods exposed; female with abdominal segments 9–11 forming conspicuous, sclerotized ovipositor (BOREINAE) 2
2. Males with a series of stout spines on outer margin of forewing; females with abdominal tergum 10 lacking caudal spiniferous extensions, tergum 10 much longer than tergum 9 (21 species, Holarctic) ..... *Boreus* Latreille

– Males with no outer spines on forewing; females with tergum 10 bearing caudal spiniferous extensions, tergum 10 at dorsal midline no longer than tergum 9 (2 species, Pacific Coast, USA) ellipsis ..... *Hesperoboreus* Penny

Penny (1977) suggested a Nearctic origin for the Boreidae, apparently because of the representation in North America of *Hesperoboreus* and the relatively plesiomorphic *nivoriundus* group of *Boreus*. Five of 6 species of the latter group are American; 1 species, *B. beybienkoi* Tarbinsky, occurs in central Asia (Penny, 1977).

Caurinus, like *Hesperoboreus* and *Boreus elegans* Carpenter, appears to be restricted to the Pacific coastal region of North America, in areas with moist, mild winters (Cooper, 1974; Penny, 1977). It is possible that *Caurinus* and *Hesperoboreus,* at least, diverged before boreids became adapted to areas with more rigorous, continental climates.

The inclusion of *Caurinus* in the Boreidae makes the modified male forewings and the maxillo-labial fusion (presence of zygostipes) the most diagnostic characters for adults of this family. It is not clear whether other structures which are characteristic of the Boreinae, including the ovipositor and the large peg-like spines of the maxillae, evolved after separation of *Caurinus* or were lost in the evolution of the latter genus. Ongoing studies of the biology and morphology of *Caurinus* and *Hesperoboreus* may help to clarify the origin and evolution of the Boreidae.

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Note

Pinnaspis caricis, New Synonym of *Pinnaspis aspidistrae* (HOMOPTERA: DIASPIDIDAE)

Pinnaspis caricis Ferris (1957. Proc. Hawaii. Entomol. Soc. 16(2):212) was described from specimens collected on *Ophiopogon japonicus* (Thunb.) Ker-Gawl. (=*Mondo japonica* (Thunb.) Farw.) at Honolulu, Hawaii. According to the description, the median lobes are fused into a single lobe. Because of this character, Ferris compared the species with *Pinnaspis uniloba* (Kuwana) which has fused median lobes but does not otherwise closely resemble *P. caricis*. Ferris also stated that the male of *P. caricis* is not known.

In the type-specimens of *P. caricis* that I examined, the median lobes are not fused but are closely appressed. *Pinnaspis caricis* is identical with *Pinnaspis ophiopogonis* Takahashi (1952. Misc. Rpt. Res. Inst. Nat. Resources Japan. 27:11), which is currently considered a junior synonym of *Pinnaspis aspidistrae* (Signoret) (1869. Ann. Entomol. Soc. Fr. (ser. 4) 9:443) (Takagi. 1970. Insecta Matsumurana. 33(1):106). Although *P. caricis* and *P. ophiopogonis* are apparently parthenogenetic and restricted to few host-plants such as *Liriope* sp., *Ophiopogon* sp. and *Rohdea* sp., there is no reliable morphological character to differentiate them from *P. aspidistrae*. Therefore, until a reliable morphological distinction is found, I think *P. caricis* is best treated as another junior synonym of *P. aspidistrae* (NEW SYNONYM).

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